Insights

A publication of the Ontario Forest Research Institute

Ontario Forest Research Institute
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Wood products make an important contribution to carbon storage

By Abigail M. Obenchain

The latest word from three carbon budget modellers at OFRI is that Ontario's forests are projected to be carbon sinks over the course of this century. What's more, forest management can increase the amount of carbon that forests store.

"Contrary to what some people think, cutting trees does not mean the carbon in those trees is immediately released to the atmosphere," says Michael Ter-Mikaelian, an OFRI research scientist who is working with OFRI's Steve Colombo and Jiaxin Chen to model Ontario's forest carbon budget. "If you were to leave those cut trees to rot or burn, then, yes, they would begin to give off carbon immediately. But that's not the case with forest harvesting in Ontario."

Chen explains, "Most harvested wood that goes into forest products continues to store carbon, usually for many years. Even most paper is either recycled or goes into landfills where decomposition occurs so slowly that paper emits little carbon."

Colombo adds, "Forests go through a natural cycle that includes growth – taking carbon dioxide from the atmosphere; maturity – storing carbon but with minimal change in carbon inputs and outputs; decay and death due to fire or other causes – resulting in carbon release; and re-establishment – growing increasingly fast and taking in carbon more and more rapidly as new trees regenerate and surpass competing vegetation. Sustainable management of boreal forests allows wood from a portion of the stands that have been protected from natural disturbance to be harvested, to be turned into wood products, and to store carbon for the long term, rather than decaying or being burned."

Colombo also points out that using more wood construction materials and less steel and aluminum reduces Ontario's carbon footprint because wood products take less energy to produce. What's more, the Ministry of Natural Resources is investigating taking unused biomass, such as branches from cut trees and poor-quality trees, to make biofuel, an alternative that could further reduce the carbon footprint. Canada's forest industry, one of Canada's leading industries for reducing greenhouse gas emissions, has already been using waste wood as a fuel to reduce its oil and gas use.

Recent estimates of forest carbon storage in Ontario are presented in MNR Climate Change Research Information Note No. 6, entitled *Carbon Storage in Ontario's Forests, 2000-2100*. this note describes how Ter-Mikaelian, Colombo, and Chen have modified the U.S. national forest carbon model, FORCARB2, to predict Ontario's forest carbon budgets using outputs from the ministry's Strategic Forest Management Model (SFMM).

"FORCARB-ON is designed to make forest carbon projections for Ontario congruent with forest management planning," Ter-Mikaelian explains. "It predicts carbon in live trees, understory vegetation, the forest floor, standing and downed wood, and soil. In addition, it has a module that simulates the effects of wildfire on forest carbon."

Recent model projections include that in 2000, Ontario's managed forests (including wood

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products) stored 6,320 million tonnes of carbon. Northwestern Ontario stored the most carbon (2,921 million tonnes), followed by the Northeast Region (2,574 million tonnes), and the Southern Region (687 million tonnes).

What's more, Ontario's stored forest carbon (including that in wood products) is expected to grow by 7 percent over this century, removing an additional 1,591 million tonnes of carbon dioxide from the atmosphere. Most of that growth in stored carbon will be in wood products.

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Predicting Ontario's future climate

By Miranda Kasubeck

With climate change at the forefront of public discussion, policymakers and planners are feeling the heat to make Ontarians aware of the potential effects of a warming world on people, infrastructure, and the environment.

To manage resources under climate change, scientists need to determine how greenhouse gas emissions are expected to affect the climate, so that government and private enterprise can decide when to act, what actions to take, and whether it is better to be proactive or to react to changes as they occur. But how serious is potential climate change, and how should we prepare for it?

To try to answer this question, staff with the Ministry of Natural Resources' Applied Research and Development Branch worked with the Canadian Forest Service to understand potential future climates for Ontario. OFRI research scientist Steve Colombo was lead author of the resulting report, entitled *Climate Change Projections for Ontario: Practical Information for Policymakers and Planners*. The report and companion CD-ROM provide an overview of Ontario's future climate using scenarios of potential greenhouse gas emissions resulting from human activity in the 21st century.

The science of climatology predicts that greenhouse gases from industrial emissions are causing dramatic climate change by altering the amount of the sun's energy trapped in the atmosphere. Colombo and his co-authors – Dan McKenney and Kevin Lawrence of the Canadian Forest Service and the ministry's Paul Gray – used projections of Ontario's future climate to encourage people to think about measures that could reduce greenhouse gas emissions and avoid harmful effects of climate change.

"The report is written in plain language to try to avoid the technical content getting in the way of the messages about climate change," Colombo says. "This report will be useful to anyone with an interest in the topic. The information is intended to get people thinking about climate change and taking it into account before making a decision that will have consequences for 20, 40, or 100 years."

The authors conclude the report by stating that if we reduce greenhouse gas emissions and plan for climate change and its effects, we can better prepare and adapt to sustain our future forests while providing a more liveable Ontario.

To obtain a CD-ROM containing an electronic version of the report (Climate Change Research Report CCRR-05) as well as a set of maps related to researchers' projections, call the OFRI publication request line at (705)946-2981, ext. 271, or e-mail information.ofri@ontario.ca. Visit www.gogreenontario.ca to try out the Climate Change Mapping Browser.

Research on fire regimes is supporting key forest policy priority: Emulating natural disturbance

By Lisa J. Buse

Boreal forests are adapted to periodic natural disturbances such as fire. As a result, they are likely to be resilient to management that mimics or *emulates* those disturbances. That's the premise behind the Ministry of Natural Resources' *Forest Management Guide for Natural Disturbance Pattern Emulation* (NDPE guide), released in 2001.

For this guide to be effective, its directions for forest harvest need to represent natural fire characteristics and patterns, which are referred to collectively as a *fire regime*. But what are the natural patterns? How do they vary over space and time? How do we ensure that forest management practices emulate those patterns at various scales, in space and time, and in a practical and feasible manner?

In 2003, Condition 39C of the *Declaration Order Regarding MNR's Class Environmental Assessment Approval for Forest Management on Crown Lands in Ontario* directed the ministry to develop an action plan for scientific studies to reduce uncertainties in the NDPE guide directions. The report entitled *An Analysis of Literature on Natural Fire Disturbances in Relation to Ontario's Forest Management Guide for Natural Disturbance Pattern Emulation* (Forest Research Information Paper No. 159) captures the initial findings of this effort. Following the action plan's approval in 2004, research scientist Ajith Perera and I began implementing the research studies outlined in the plan.

What do we hope to learn about natural fire regimes?

We are investigating various aspects of boreal fire regimes at the landscape, stand, and site scales. At the landscape scale, we are determining:

- How does the distribution of boreal forest fire sizes vary over space and time?
- What are the probability and variability of spatial occurrence of fire events?
- Can that variation be explained by differences in geography or climate?

At the stand and site scale, we are investigating:

- What are the types and extent of post-fire residual structure (trees left after fire)?

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- How do site and stand conditions before a fire affect the distribution of residual structure?
- What happens to the structure in the first few years after fire?

We have been using a variety of investigative approaches, such as:

- Reviewing and synthesizing the published literature
- Using simulation modelling to determine the characteristics of the broad-scale fire regime
- Using mapping and monitoring to reveal the extent and spatial patterns of post-fire residuals

We have summarized the rationale and approaches for the studies in *Multiple-Scale Research Studies on Boreal Forest Fire Regimes to Inform Ontario's Policies for Emulating Natural Forest Disturbances: A Prospectus* (Forest Research Information Paper No. 164).

Photo: MNR archives

OFRI's landscape ecology researchers are investigating natural fire characteristics and patterns to help ensure that forest management emulates natural disturbance (fire) as closely as possible.

What have we learned so far?

We're about halfway through the project, and the studies are now generating results. It turns out we don't know as much as we would like to about fire regimes and residual structure after fire. Because fires are highly probabilistic (random), and many variables influence fire events and their outcome, generalizing fire patterns may be difficult. The one constant seems to be fire's variability.

We do know that the boreal forest does not have a single fire regime: It varies in space and time. Since fire regimes occur over large scales and long extents, they cannot be assessed directly. Thus, at the landscape level, our main focus has been to improve our simulation modelling capability by basing it on the best knowledge of fire science to better understand the potential fire regime and its variability. Since our model relies on both scientific (theoretical) and user (practical) assumptions, we are working hard to improve the underlying assumptions. Specifically, we are refining our knowledge about fire behaviour and forest succession, the mechanisms that influence fire regimes and thus drive the simulation modelling.

At the stand level, the number and size of live tree patches remaining after fire vary within and among fire events. They depend greatly on the scale and resolution at which we assess the patterns. Thus, we cannot generalize the number and location of patches that fire will leave without linking them to pre-determined objectives and scale. We have been trying to link where residual patches occur to what causes them to escape fire to indicate where to leave patches based on some combination of what we know about preburn forest cover and site conditions.

Individual residual live trees and snags (standing dead trees) also vary greatly within and among fire events. For these, we are also focusing less on estimating abundance and more on trying to explain where and why live tree residuals occur naturally, so forest managers can make better-informed choices about where to leave residuals during harvesting. Interim results show that pre-burn cover type, site conditions, fire event geometry (such as size and distance from fire edge), and proximity to and size of water bodies affect residual live tree occurrence. Many of these trees die and become snags or fall and become downed wood soon after fire.

All of the fire regime studies will be completed by mid-2008.

How are we transferring study findings?

We are presenting our results both formally and informally as we make progress. When we began, we shared planned approaches for the studies with ministry staff in policy, fire, and some districts and worked with them to refine the research questions. Since then, we have stayed in contact with staff in MNR's Forest Management Branch to support them as they develop new policies and guides.

In spring 2007, we hosted information sessions for ministry and forest industry staff in cooperation with staff from districts and the science and information units in the northwest and northeast regions. We wanted to share interim findings and get feedback about whether more or different analyses might help the end users of the new information. These efforts will help us to make use of that input during the analysis stage rather than having to circle back later. We will conduct another series of information sessions after final results are available in late 2008.

We are also ensuring that our study approaches and results are peer-reviewed and published in scientific journals and presented at scientific conferences. In addition to the prospectus, we've produced publications on topics such as fire size distribution (Forest Research Information Paper No. 163) and uncertainty in knowledge of forest succession (Forest Research Report No. 165). Look for more publications over the next year, focusing on simulation modelling advances, enhanced understanding of fire regimes, and results from field studies on residual structure after fire.

Reports mentioned in this article are available by calling the OFRI publication request line at (705)946-2981, ext. 271, or e-mailing information.ofri@ontario.ca.

Some soil and water research definitions ...

Biogeochemistry: The science of the chemical relationships among water, soil, air, organisms, and the Earth's crust within a given ecosystem.

Carbon sequestration: The removal of carbon from the atmosphere and its storage on Earth (for example, in trees or soil).

Evapotranspiration: Plants' release of water vapour to the atmosphere through their leaves.

Fen: A type of open wetland fed by groundwater in which peat often forms.

Hydrology: The science of water properties, distribution, and circulation and their effects on the earth and atmosphere.

Peatland: A generic term that refers to wetlands that are covered with peat, an organic material that consists of the partially decayed remains of plants.

Riparian zone: The land and vegetation bordering flowing or standing water (streams, lakes, etc.).

Watershed: All the land that drains into a given river system or water body.

Watershed carbon budget: Amounts of carbon being taken in, released, and stored in a given watershed.

Photo: John Ralston, OFRI

The latest on how soil and water research is supporting sustainable forest management

By Lisa J. Buse

OFRI's soil and water research scientist Jim McLaughlin is working hard to clear up the muddy unknowns of how forest management affects soil and water in Ontario's forests.

Since its creation in 2000, OFRI's Forest Soil and Water Research Program has expanded to cover many issues relevant to current ministry priorities. The overall focus, according to McLaughlin, is on how silvicultural interventions (such as forest harvesting), natural disturbances, and climate change affect carbon and nutrient dynamics, water flow, and forest and aquatic productivity in Ontario's boreal forest.

What soil and water research is underway, and how does it link to forest management and policy?

McLaughlin has chosen to focus his soil and water research in three areas, all of which rely on field studies:

- ***Riparian zone management***: Studying how water table fluctuations affect alkalinity (pH) changes and nutrient flow to streams from riparian fens. Also under study: How natural disturbance and human activities affect watershed hydrology.
- ***Silviculture and soils***: Investigating and modelling how forest carbon and nutrients change in different forest types over time, as well as how water table changes affect soil carbon sequestration, nutrient cycling, and forest productivity
- ***Climate change-related research***: Defining watershed carbon budgets and understanding the role of upland forests, riparian zones, peatlands, and aquatic ecosystems in Ontario's carbon balance and attempting to integrate these four components into a framework for boreal forest management

"Up to 40 percent of the landbase in Ontario's boreal region is interconnected forest, wetland, and freshwater ecosystems," McLaughlin emphasizes. "These riparian zones act as critical carbon and water transfer points."

This riparian work, conducted in partnership with the Canadian Forest Service-Great Lakes Forestry Centre, is focused on a site near White River, where ministry researchers are monitoring the effects of forestry practices on stream flow as well as carbon and nutrient cycling and fluxes.

McLaughlin says "Results will be used to develop criteria and indicators for monitoring stream flow [see special report on the state of the forest report in this issue], as well as a model that forest planners can use to simulate a management plan's effects on stream flow and the cumulative effects of harvestng across spatial scales and over time."

Results to date show that upland and riparian zone harvesting in the watershed has not increased water or nutrient fluxes, although nutrient movement from uplands to riparian zones has increased. Decreased rain and snow following harvesting may be influencing the results, and McLaughlin wants to know more about how harvesting may be interacting with nutrient movement and precipitation patterns.

"Much forest research is focused how practices affect aspects such as wood volumes and plant and wildlife populations and diversity," he asserts. "Little effort goes into effects on soil and even less to water – both of which are critical to forest productivity and sustainability.

"We are determining the effects of forestry practices on soil productivity, physical properties, and nutrient cycling at four main sites – near Cochrane on the *Developing Sustainable Mixedwood Practices in a Stand-Level Adaptive Management Framework* study site, the Timmins and Kapuskasing *Intensive Forest Management: NEBIE Plot Network* study sites [see related article in this issue], and the Fluxnet Canada site near Foleyet."

They have also partnered with other agencies to gain access to more sites to test whether soil and water responses to disturbance are similar across Ontario's climatic and geological zones. The data will be used to develop and improve related spatial models for use in forest management.

Another research focus is how forest practices affect watershed carbon budgets. "We have found that different types of riparian zones process carbon at different rates," he explains. "Some are carbon sinks, while others are sources. When you incorporate riparian zone and watershed carbon fluctuations into carbon budgets, the boreal forest can go from being a strong carbon sink to a weak one. These results may be important to Canada's international carbon reporting efforts. We hope to provide critical thresholds [expected maximum

and minimum values] for carbon to support the use of criteria and indicators for state of the forest reporting."

The peatland research is focused on documenting how extracting peat for energy could affect cycling of water, nutrients, and heavy metals (such as mercury) in nearby waterbodies. This work is just beginning, and McLaughlin and his partners are still identifying research needs. They will develop a response to these needs over the next few years.

What has the program accomplished in its first five years?

The Forest Soil and Water Research Program is well established with networks of partners, projects, staff, and resources in place. McLaughlin cites the following as highlights of his first few years:

- Synthesized the state of the knowledge of and research needs for carbon cycling in wetlands (Forest Research Information Paper No. 158)
- Developed a soil and water research program strategy for Ontario (Forest Research Information Paper No. 166; see box below)
- Partnered with Ontario and Michigan universities, the Canadian Forest Service, and the U.S. Forest Service to study how forestry practices affect nutrient cycling and carbon dynamics in five Ontario watersheds, as well as to maintain and collect long-term data in harvested watersheds in Michigan and Maine
- Summarized existing knowledge and developed science priorities for wetland management and climate change
- Working with the ministry's Forest Management Branch, developed three new elements to support Ontario's five-year state of the forest report's global ecological cycles criterion: monitoring forest production of nitrous oxide, monitoring acid rain deposition, and monitoring evapotranspiration; they will continue to provide data and information for reporting on these elements (see related special report in this issue)
- Assessed current knowledge of and research needs for harvesting commercial peat (Forest Research Information Paper No. 161; see next page)
- Developed and documented rigorous quality assurance and quality control practices for collecting and processing samples

Where is OFRI's soil and water research headed?

While McLaughlin intends to continue to lead soil and water research at the provincial level, he also wants to expand his research network to include more national and international partners, thus widening the applicability of his research results.

He also hopes that the program's framework will allow him and his collaborators to integrate new knowledge into a spatial model to shed more light on how natural and human disturbances affect the biogeochemistry and hydrology of Ontario's forest landscapes.

Photo: Ted Allinson, OFRI

OFRI research technician John Ralston extracts a water sample from a riparian fen in White River.

For more information about OFRI's Forest Soil and Water Research Program, contact Jim at (705)946-7418, jim.mclaughlin@ontario.ca. To request a copy of any of the publications mentioned in this article, call the OFRI publication request line at (705)946-2981, ext. 271, or e-mail information.ofri@ontario.ca.

Charting a course for Ontario's forest soil and water research

By Miranda Kasubeck

The flow of water, carbon, and nutrients through forested landscapes is critical to forest and aquatic productivity and sustainability. However, the chemical linkages among different ecosystem components in northern Ontario are poorly understood. The Forest Soil and Water Research Program at OFRI strives to improve the knowledge base in this area.

OFRI research scientist Jim McLaughlin has outlined how this improvement will be accomplished in the recently published *Forest Soil and Water Research Program: Five-Year Research Strategy 2006-2011*. It outlines short (<1 year), intermediate (1-3 year), and long-term (3-5 year) tactical goals for three major soil/water research areas: riparian zone management, silviculture and soils, and climate change (see related article for details).

"This research is important because it addresses poorly understood issues that affect key ministry policies," McLaughlin says. "Through this research, we hope to better understand how forests, wetlands, and aquatic ecosystems are hydrologically connected and how these connections contribute to carbon sequestration and water quality, so resource managers can make better-informed management and policy decisions."

To obtain a copy of the strategy (Forest Research Information Paper No. 166), call the OFRI publication request line at (705)946-2981, ext. 271, or e-mail information.ofri@ontario.ca.

OFRI STAFF PROFILE

By Lisa J. Buse

Getting dirty and wet is all in a day's work for research scientist Jim McLaughlin. His research focuses on understanding ecological processes related to soil and water, which provide the structural foundation for forest ecosystems and supply essential nutrients such as nitrogen and phosphorus to trees and plants. Forest soil is also home to micro-organisms that make nutrients available to trees.

As McLaughlin points out, changes to forest soil water, whether they result from natural disturbance or human activities, can significantly change the larger ecosystem, including which species of trees and other vegetation (and thus wildlife) occupy the site.

His current focus is evaluating the interactions among landscape factors, forest harvesting, and wildfire on soil nutrient cycling, hydrology, and water quality. He has been providing much-needed research information about the potential environmental effects of proposed commercial peat harvesting in Northwestern Ontario to support developing ministry policy.

He also provides research information for Ontario's sustainable forest management guidelines and state of the forest reporting and transfers new information related to forest soils and water to the forest industry, provincial agencies, environmental groups, and the general public.

McLaughlin is an adjunct professor at Michigan Technological University in Houghton and earned a PhD in forest soils from that institution in 1992. He has a range of professional experience, including stints as a senior environmental planner and a regional water quality coordinator in Texas, a research professor at the University of Maine in Orono, and a research scientist at Michigan Tech.

He grew up in Michigan's Upper Peninsula and has also worked as a medical technician assisting with cardiopulmonary research on premature baboons, as a U.S. Air Force medical service specialist in a neonatal intensive care unit, and as a logger in northern Wisconsin. In the winter you'll find him snowshoeing and in the summer he plays baseball in his spare time.
You can reach him at (705)946-7418, jim.mclaughlin@ontario.ca.

The potential of peat as a fuel source

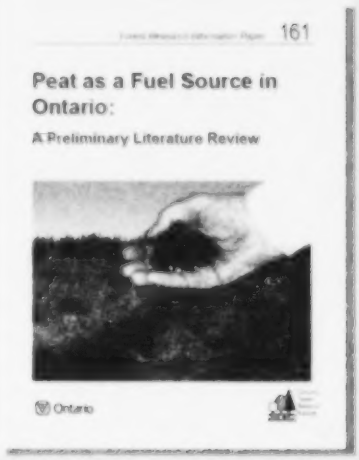
By Lori Rudzki

Is any other fuel source more efficient than what is now being used? According to a literature review published by OFRI, many researchers have been working to answer this question by studying the rewards and drawbacks of peat.

Plentiful in northern Ontario, *peat* is the remains of plants that have accumulated over time in wetland areas but have not fully decayed due to acidic and anaerobic conditions. People in countries such as Ireland have used peat as fuel for hundreds of years.

Peat as a Fuel Source in Ontario: A Preliminary Literature Review provides insight into the Ministry of Natural Resources' peat initiative and an analysis of peat's potential as an alternate fuel source. According to OFRI research scientist Jim McLaughlin, who coauthored the report, "This review discusses the advantages and disadvantages of peat as a fuel source and summarizes critical knowledge gaps related to extracting peat."

Lead author Jenny Gleeson, from the Ministry of Natural Resources' Renewable Energy Section, explains that "the review is feeding into the development of a peat extraction policy framework and may help to inform future ministry policy decisions."



The review was compiled by Gleeson and McLaughlin with Alex Zeller, formerly with the ministry's Centre for Northern Forest Ecosystem Research. This publication:

- Focuses on peat functions, types, and economic value, as well as resource extraction and harvesting methods
- Addresses the cumulative impacts of mining peat, emphasizing the socio-economic opportunities as well as the environmental impacts and other challenges
- Considers peatland restoration and mitigation techniques

"This review provides a basis for future discussions about the extraction and allocation of peat as a resource, associated land use policy, implications to climate change, ecological impacts to wetlands, and potential alternatives," McLaughlin asserts.

To obtain a copy of the review (Forest Research Information Paper No. 161), call the OFRI publication request line at (705)946-2981, ext. 271, or e-mail information.ofri@ontario.ca.

Forest industry adopting NEBIE intensive forest management framework

By Lisa J. Buse

When OFRI research scientist Wayne Bell began establishing a network of research plots across Ontario in 2001 to study silvicultural intensities, he did not foresee engaging in major terminology discussions or influencing forest industry's management planning approach.

"I've always been frustrated by the lack of consistency in defining silvicultural intensities and treatments," Bell states. "After many years of effort by many individuals, helped along by the *Ontario Forest Accord*, the Ministry of Natural Resources has agreed on definitions of intensity for silviculture. Now we can work towards operational applications based on these definitions."

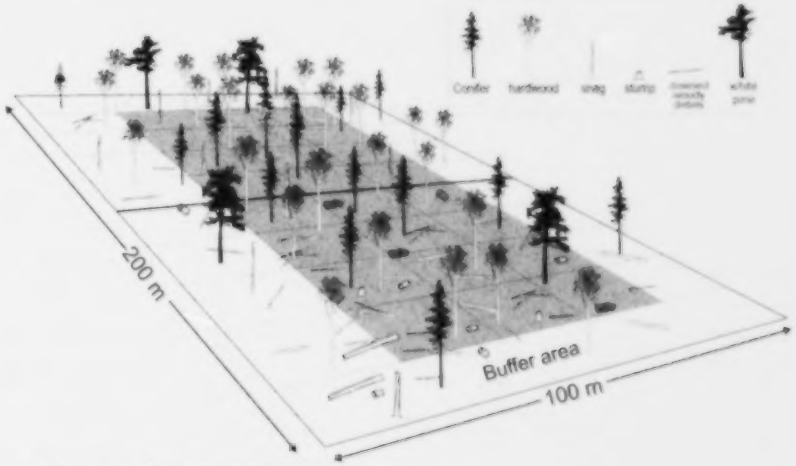
Jeff Leach, Tembec silvicultural specialist based in Kapuskasing, recently adopted the NEBIE framework as a means to incorporate silvicultural objectives in the forest management plan under development for the Romeo-Mallette Sustainable Forest License. Leach emphasizes, "The NEBIE framework has provided a way of organizing our silvicultural objectives and treatments by intensity level. The network benchmarks the intensities and provides a common language for communicating about silvicultural practices, a framework within which to apply treatments consistently, and a meaningful way to track treatment effects through time.

"When we do our planning, we have results from the plot network to point to," he continues. "As well, I see the network as providing a reference point to tie in other aspects of forest management, such as species- and site-specific yield curves for managed stands." (*Yield curves* are projections of how stand volume will grow over time.)

What is the purpose of the NEBIE plot network?

"Past silviculture research has studied the effects of individual treatments, such as stock type, vegetation management, or thinning, on specific stages of forest crops," Bell explains. "Although results of this research have been used to develop silviculture guides, many uncertainties exist, making it difficult to apply the results to growth and yield predictions.

"What's different about the NEBIE plot network is that rather than studying the effects of individual treatments in the short term, we are looking at how eight common forest types respond to treatment portfolios over the longer term. These treatments range from letting nature take its course to using typical silviculture practices to applying more intensive practices. Hence the acronym *NEBIE*, which stands for **n**atural disturbances and **e**xtensive, **b**asic, intensive, and **e**lite levels of silviculture – the range of intensities being studied across the managed forest area of Ontario."



Sample treatment plot layout for Dryden NEBIE site.

The NEBIE approach is similar to the TRIAD approach used in B.C. and Quebec, which recognizes natural, extensive, and intensive treatments. With TRIAD, all artificial regeneration efforts are considered intensive, but NEBIE recognizes four levels of investment – extensive, basic, intensive, and elite.

According to Bell, NEBIE researchers are not only determining the effects of natural disturbances and the range of silvicultural practices on forest crops, including tree survival, growth, wood quality, and genetic diversity, but are also monitoring effects on other aspects of the forest, such as microclimate, soil moisture and nutrient cycling, vegetation diversity, and wildlife habitat.

"We hope to provide forest managers with a complete picture of the pros and cons of their management efforts by forest type," Bell emphasizes. "Ultimately, we are aiming to develop a defensible database to accurately forecast allowable cut while maintaining the ecological and economic viability of Ontario's managed forests."

Why do we need a NEBIE Plot Network?

NEBIE supports current ministry priorities including:

- Ontario's biodiversity strategy – by tracking how various forest management intensities affect native and invasive non-native plant species
- Provincial wood supply strategy – by monitoring 640 permanent growth plots in eight forest types to help improve managed stand yield curves that are linked to current practices and can be applied in forest management planning
- Silviculture strategy – by developing clear definitions and common standards for silviculture intensities and related practices
- Biofibre policy – by monitoring the environmental effects of removing biomass in various forest types

Jeff Leach cites more operational applications: "What industry needs is *just-in-time* delivery of forest products. As the landbase available for forestry shrinks, we're looking to results from the NEBIE network to help us plan for specific products within a given timeframe, sustainably produced to meet our forest management objectives and certification criteria. Data from science-based plot networks such as NEBIE, combined with enhanced forest resource inventories and spatial models, will help to get us there."

Bell points out that they ensured that the study sites are within a short drive of a major centre.

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Al Stinson of the ministry's Southern Science and Information Section has worked closely with the Canadian Ecology Centre-Forestry Research Partnership (CEC-FRP) since NEBIE's inception, and he reports that he often uses the site near North Bay. "The network plots are great for tours – an easy way to explain the complexities of forest management to audiences such as attendees of the CEC-FRP annual teacher tours, visiting delegations, and students," Stinson says. "We visit the site regularly for workshop and conference field tours."

The network is also available to other researchers. For example, in partnership with Nipissing Forest Resource Management, OFRI research scientist Tom Noland has established Canada yew on the elite treatment plots on the North Bay site. "We jumped at the opportunity to establish a newly developing non-timber forest product on a semi-operational site," he says. "We hope to document that more than just wood fibre can be produced on these sites, to diversify and hopefully increase their economic potential."

What have we learned so far?

The network of 160 two-hectare plots is beginning to yield information. For example:

- ***Natural forest diversity***: Pre-harvest species diversity ranged from 72 species in the jack pine-black spruce forest on sand near Sioux Lookout to 244 species on the 100-year-old mixed white pine site near Petawawa. No alien species were found on any of the sites prior to harvest.
- ***Coarse wood volumes***: Pre-harvest volumes ranged from 16 metric tonnes per hectare on a 91-year-old forest near Timmins to 64 metric tonnes per hectare on a 112-year-old forest near Kapuskasing; both were conifer mixedwood forests that originated from burns.
- ***Pre-harvest merchantable volumes***:
  - Petawawa (white pine, red pine, sugar maple mixed): More than 300 cubic metres per hectare
  - Timmins and Kapuskasing (mixedwoods): About 225 cubic metre/hectare
  - Sioux Lookout (jack pine-black spruce) and North Bay (hard maple): About 180 cubic metres/hectare
  - Thunder Bay (aspen mixedwood) and Wawa (birch mixedwood): Less than 150 cubic metres/hectare
  - Dryden (mixedwood): 65 cubic metres/hectare

What are the next steps?

All of the pre-treatment data have been collected. All but two sites (Wawa and Thunder Bay) have been harvested, and regeneration treatments have or are now being applied. Bell and his partners will summarize pre-treatment data to provide a baseline for comparing future treatment effects. They are starting to collect post-treatment data to quantify the effects on tree growth, plant diversity, coarse wood, and soils. Look for a project establishment report in early 2008.

For more information about the NEBIE plot network, visit the *Research* page of OFRI's website (ofri.mnr.gov.on.ca) or contact Wayne Bell at (705)946-7401, wayne.bell@ontario.ca. To get a copy of *Is Intensive Forest Management a Misnomer? An Ontario-Based Discussion of Terminology and an Alternative Approach*, call the OFRI publication request line at (705)946-2981, ext. 271, or e-mail information.ofri@ontario.ca.

The top priorities for improving Ontario's wood supply predictions

By Lisa J. Buse

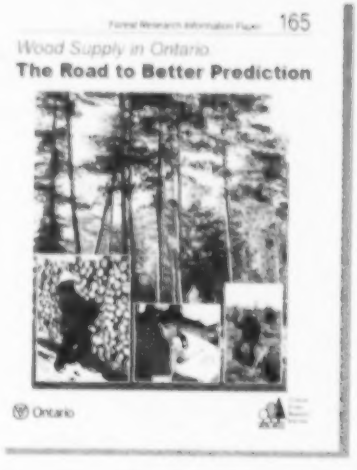
Wood Supply in Ontario: The Road to Better Prediction, OFRI Forest Research Information Paper No. 165, summarizes priorities for improving wood supply estimates based on the results of a survey of Ontario forestry professionals and a workshop that many Ontario experts attended.

OFRI research scientist Michael Ter-Mikaelian, coauthor of the report, explains, "This report highlights how other jurisdictions are addressing wood supply prediction issues, briefly summarizes Ontario's process for estimating wood supply, and outlines priorities for focusing efforts to improve wood supply predictions based on the survey and workshop results."

The top five priorities, according to report co-author Jean-Marie Sobze, who worked on this project as an OFRI forester intern (and is now a timber supply analyst in Peace River, AB):

- Improving linkages between forest resources inventory and growth and yield data
- Acquiring more realistic information to predict and validate how forest succession changes at various stages of stand development
- Developing new growth and yield curves for planted and naturally regenerated stands
- Updating the provincial forest resources inventory more often
- Assembling better data on factors affecting site productivity to include in growth and yield models

OFRI research scientist and report co-author Steve Colombo emphasizes: "This report is just the beginning. We've identified the uncertainties in predicting wood supply in general. The next steps include clearly defining each of the needs, identifying ongoing and recent projects relevant to those needs, and setting priorities, based on the time and cost of addressing each need and the importance of each to improving wood supply estimates."



One completed study focused on comparing aerial and ground-based methods of assessing tree species composition in the Nipissing Forest near North Bay (see article on next page).

To obtain a paper copy of *Wood Supply in Ontario: The Road to Better Prediction* (Forest Research Information Paper No. 165), call the OFRI publication request line at (705)946-2981, ext. 271, or e-mail information.ofri@ontario.ca.

Air- and ground-based methods for assessing tree species composition: How well do they agree?

By Abigail M. Obenchain

If Ontario's wood supply predictions are to be improved, then the Ministry of Natural Resources must upgrade the province's forest resources inventory (FRI). So decreed many of the forestry professionals who participated in the ministry's exercise to set priorities related to increasing the accuracy of wood supply prediction (see article on previous page).

Given this direction, OFRI research scientist Michael Ter-Mikaelian and former research intern Jean-Marie Sobze jumped at the opportunity to work on a study to assess the level of agreement between species composition data collected via aerial FRI photos and that collected on the ground for the Nipissing Forest near North Bay.

"For a long time, I have been interested in how FRI data stacks up against data collected through field measurement," Ter-Mikaelian says. "Inaccuracies are always going to occur, but it's important to try to minimize them and to determine the range of variation."

Fred Pinto of the ministry's Southern Science and Information Section in North Bay and Dan Rouillard of the ministry's Forest Analysis and Modelling Unit in Sault Ste. Marie led the study, which focused on validating tree species composition data, a key attribute in a forest inventory. Pinto explains that this attribute is presented as a list of tree species with the percentage of crown area each occupies in the stand (to the nearest 10 percent).

Forest stands that are near each other and have similar species composition are lumped together into forest units, each of which is managed using a single silvicultural system. "Forest units form the basis for forest management planning in Ontario," Pinto says. "They are used to estimate and predict timber and wildlife habitat supply and to predict how forests will change due to natural or human disturbance, such as harvesting."

Given the importance of species composition data to forest management planning, minimizing error is critical. According to Pinto, however, relatively little effort has gone into validating data derived from aerial photos by comparing it with data collected on the ground. Most studies have focused on comparing various systems of collecting data from the air. Thus in 2003, field crews collected species composition data for 136 stands in the Nipissing Forest to compare with data derived from aerial photos of the same forests.

Photo: Mark Lockhart, Nipissing Forest Resource Management

The Nipissing forest near North Bay was the site of a study that involved comparing tree composition data derived from aerial photos with that collected on the ground.

"Overall, the estimates of species composition derived from aerial photos and those from field data were in agreement about 54 percent of the time," Ter-Mikaelian reports. "This may sound disturbingly low, but a study in British Columbia – the only similar study we found – had similar results.

"Keep in mind that the aerial photos were taken 14 years before the ground data were collected. Between 50 and 60 percent agreement is probably the best we can expect given the FRI technology of the time. Also remember that a photo interpreter can only see the top of the forest. A technician collecting data on the ground has a very different view, so differences are expected."

Other factors that could have affected the level of agreement between the two datasets include differences in how stands were lumped into forest units and how cruise lines were established.

With rapid advances in remote sensing technology and a new enhanced FRI program underway – one that will mandate updates every 10 years rather than every 20 – Ter-Mikaelian is hopeful that agreement between remotely sensed and ground data and our understanding of the confidence intervals for FRI will likely improve.

However, he cautions that it's important for users of FRI data to remember that it was not designed to be accurate in every single stand. "That was never the purpose of FRI," he points out. "It would be prohibitively expensive to do that much calibration. We can continue to improve the accuracy of FRI and to determine confidence intervals for FRI attributes so we can set boundaries around predictions, but we must have realistic expectations and avoid using it for purposes it was not designed for."

For more information about this study, order a reprint of *The Forestry Chronicle* article entitled *Validating Tree Species Composition in Forest Resource Inventory for Nipissing Forest, Ontario, Canada*. You can call the OFRI publication request line at (705)946-2981, ext. 271, or e-mail information.ofri@ontario.ca.

Insights Special Report

A supplement to *Insights*, Volume 8, Number 1 ~ Summer 2007

Ontario's second state of the forest report an important step forward ... but yes, we need more science

By Abigail M. Obenchain

Are Ontario's forests being managed wisely? Will they and all their values - timber, wildlife, recreation, and much more - be here for our children and grandchildren to use and enjoy? What's going well when it comes to forest management in Ontario? What areas do we need to improve?

In the *State of the Forest Report 2006*, the Ministry of Natural Resources attempts to answer these questions using data and information from a range of sources, including OFRI. Read on to find out more about why you should take a look at this report, what OFRI has contributed to it, and what the future holds for state of the forest reporting.

What is the state of the forest report?

"This report updates the state of Ontario's forests adding information from April 1999 to March 2004," explains Bill Dalton, a forest ecologist with the ministry's Forest Evaluation and Standards Section in Sault Ste. Marie and a member of the report production team. "Since the ministry's mission is ecological sustainability, we need to be able to demonstrate that we are managing Ontario's natural resources to ensure they persist for future generations to use and enjoy."

He adds that the *Crown Forest Sustainability Act* and Condition 33 of the *Class Environmental Assessment Approval for Forest Management on Crown Lands in Ontario* require the ministry to report on the state of our forests every five years.

"This report is complex," he says. "As steward of Ontario's forests, the ministry reports on the social, economic, and environmental aspects of forest management for Crown lands and waters, which make up 87 percent of the province and cover about 94 million hectares. Ontario has more forest - 71 million hectares - than Finland, Sweden, France, and Germany combined. That's a huge responsibility."

The current report, which at press time was waiting to be tabled in the Legislative Assembly of Ontario, provides much more information than the previous and first report in 2001. The final products will consist of:

- A paper summary (30+ pages) of the 2006 report, available in both English and French
- A CD-ROM that contains electronic versions of:
  - The full 2006 report (770+ pages; English only) plus the 2001 edition
  - The companion *Forest Resources of Ontario* report (both 2006 and 2001 editions)
  - Forest management annual reports dating back to 1997-98
  - Many forest management guides, policies, information notes, and related documents
  - A variety of map and image files, such as a map showing the owners of Ontario's productive forests
  - Detailed census information broken down many ways, such as by forest region

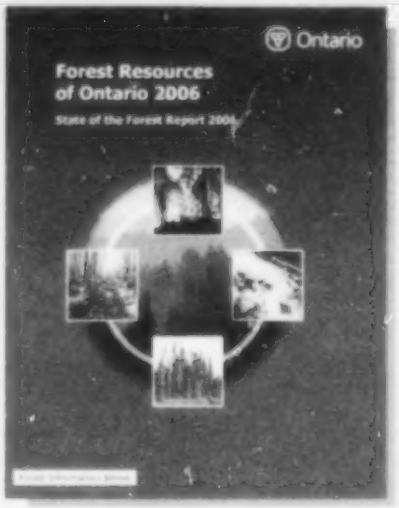
"We have tried to provide the information in this report in as plain language as possible to ensure it is accessible to all the people of Ontario who are concerned about our forests," Dalton says. "However, it will be especially useful for those who are monitoring forest management, whether they work for forest industry, another government ministry or agency, or a stakeholder group. It will also be useful to those at the national and international levels who are interested in comparing what's happening in Ontario's forests with what's happening across Canada or in other countries."

How does the ministry evaluate the state of Ontario's forests?

It's a tall order to determine the status of 71 million hectares of forest, ranging from the vast boreal in Ontario's north to the Great Lakes-St. Lawrence forests in the province's centre to the fragmented Carolinian forests of the province's southern tip. It takes huge amounts of research, data, and information.

The ***Forest Resources of Ontario*** is a companion report that the ministry published in late 2006 that is used heavily for indicators of sustainable forest management. "Ontario has been reporting on these snapshot forest statistics since the 1920s," says Larry Watkins, provincial forest analyst and the driving force behind *Forest Resources of Ontario*.

The report describes Ontario's landbase, geological history and soils, climatic conditions, and forest and ecological regions. It also gives the numbers for Ontario's managed forest area, such as the area, age, and volume of trees for each forest cover type; tree species distribution, growing stock, and growth by species; changes in Ontario's forest over the past 20 years; and spatial arrangement of forests across the landscape. Chapter 2 of the state of the forest report provides a summary of *Forest Resources of Ontario*.



Ontario, through Canada, is party to the United Nations *Statement of Forest Principles*, including reporting of forest status and trends using ***criteria and indicators***. "Ontario has seven criteria for sustainable forest management, which closely follow the national and international criteria and indicators to enable meaningful comparisons," Dalton explains. "These criteria are values that we want to sustain, such as biological diversity or forests' economic and social benefits. They are fairly general, so we've divided each into more specific elements. For each element, we have a series of indicators, either descriptive or numerical, each of which is supposed to show whether the element is gaining or losing ground."

Reviewing the information collected for Ontario's indicators of sustainability provides a fairly accurate picture of the status of Ontario's forests. *The State of the Forest Report 2006* helps the people of Ontario understand where our forests are at and how they are changing.

What's the catch, and where does science fit in?

Ontario's criteria and elements were chosen to represent the range of forest values that the people of Ontario feel are important, from healthy forest ecosystems to socioeconomic benefits to an effective set of policies, laws, and guidelines to support forest management. However, as Dalton points out, the devil is in the details, and in this case, that means the indicators.

"One of the key improvements to the report this time around is that a science expert has weighed in on each indicator's condition, trend, and data quality," he says. "Even so, Ontario's indicators are relatively immature. Some of them need more scientific validation. Some are indirect, which means they don't actually provide direct quantitative information for the value they supposedly represent. Rather, they suggest the element's condition based on an assumed relationship between the indicator and its element."

For example, compliance with forest management guidelines for protecting water quality is an indirect indicator of Element 3.2, minimizing effects of forest management practices on water resources. A direct indicator would measure how well our water resources are functioning rather than whether a plan to protect them was completed.

According to Dalton, direct indicators are usually better - if we clearly understand the process they represent and if they are measurable. However, collecting data on direct indicators can be very costly, especially for Ontario's huge forest area. What's more, research/science staff may not yet know how to measure a given indicator directly or even to pinpoint which one accurately represents the status of a given element.

"One thing we do know is that indicators of sustainability offer many opportunities for research scientists," Dalton says. "Unfortunately and perhaps unavoidably, to date we have not always been using their expertise and information in the most appropriate ways because we had no alternative. For example, we may be using data from an existing five- or 10-year research-scale study to feed into an indicator, when what we need is data from ongoing provincial monitoring programs, which are more appropriate for feeding into state of the forest reporting. Over time, we hope to see that change."

An important role for researchers is to help ensure that the ministry is using valid indicators, whether direct or indirect. "We may be assuming that the relationship between an affordable measure and the resource condition is there," Dalton says. "Scientists can determine whether we are making safe assumptions."

Many ministry research and science staff have lent their expertise and/or data to *State of the Forest Report 2006*. Following is a list of OFRI contributions:

- **Wayne Bell** used two University of Guelph tools that OFRI had a hand in - the *Flora Ontario Integrated Botanical Information System* and the *Quantitative Biodiversity Database* – to describe the status of invasive and exotic species. Ontario has the highest proportion of invasive alien species in Canada (34 percent), but this level is similar to those in nearby U.S. states. This indicator represents conserving species diversity (Element 1.2).
- **Pengxin Lu** determined whether the genetic diversity of seeds from Ontario's seed orchards is sufficient to conserve genetic diversity of Ontario's two most important economic species (black spruce and jack pine) - and yes, it is. This indirect indicator represents conserving genetic diversity (1.3).
- Using the new FORCARB-ON forest carbon budget model, **Michael Ter-Mikaelian, Steve Colombo**, and **Jiaxin Chen** calculated Ontario's net primary productivity and found that the province's forests appear to be growing well, but better data are

needed for parks, fire protection zones, and private lands. They also projected the net carbon balance and found that Ontario's managed forests will be weakly positive considering standing forest carbon alone, but will contribute a large carbon store in wood products. These indicators represent forest productivity (2.1) and global carbon enrichment (4.1), respectively.

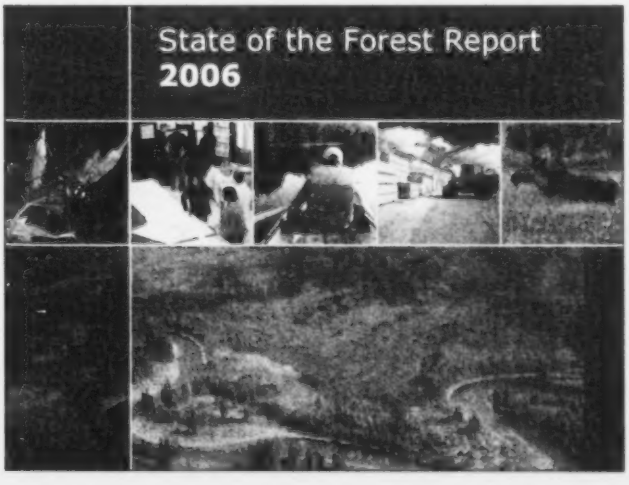
- **Jim McLaughlin** was the expert behind five indicators:
  - He found that compliance with guidelines for protecting water quality and fish habitat is generally high. These two indirect indicators represent minimizing the effects of forest management practices on water resources (3.2). McLaughlin is conducting research to produce better indicators.
  - He provided information about nitrogen and sulphur cycling. Less oxides of nitrogen and sulphur dioxide (via acid rain) are falling on Ontario's forests, but the levels are still too high. These two indirect indicators represent monitoring nutrient cycles (4.3).
  - He provided information about snowfall and temperature trends as evidence of changes in water availability that suggest modifications to forest growth and yield models may be needed. This indirect indicator represents monitoring the water balance (4.4).
- **Tom Noland** compiled information about Canada yew, a leading source of a chemical used in an important cancer drug, for a temporary indicator of trends in value-added non-timber forest products. Non-timber forest products appear to have great potential to create jobs, but little data is available about their current role in Ontario's forest-based economy. This indicator represents monitoring and supporting value-added products and services (5.3).

Chapter 4 of the *State of the Forest Report 2006* presents much more detail about these and other indicators, including how values for those used in both the 2001 and 2006 reports have changed over time.

The bottom line: How are Ontario's forests doing?

The *State of the Forest Report 2006* shows that overall, Ontario's forests have changed little since 2001. Some other findings (for more details, see the report):

- The range of ecological features in parks and protected areas, as well as the amount of old growth forests, has increased.
- Forest industry is harvesting less than the available wood supply; however the gap between supply and demand is narrowing due to the creation of more parks and protected areas and new guidelines that protect other values.
- Wildlife harvesting appears to be sustainable, but for some wildlife species, not enough monitoring data is available.
- Two forest types that are declining: hemlock and yellow birch. Fire suppression appears to be a key factor.
- In southern Ontario, two worrisome trends are increases in invasive alien species and continuing loss of forested land to development.
- Damage to standing trees and seedlings during partial harvest generally falls within provincial guidelines and is decreasing; however, it varies greatly and needs careful monitoring.
- A gap continues to exist between areas eligible for assessment following regeneration after harvest or natural disturbance and areas actually assessed.
- As expected, land area converted to forest roads has increased, primarily where access is being established for the first time within the Area of the Undertaking. More detailed analysis of road effects will be possible in the future, as changes in reporting requirements for forest management planning will produce more data about roads.
- Communities with forest-based economies were relatively stable on average during the reporting period, but have suffered a serious economic downturn since then.
- Most local citizens' committee members believe that the forest management planning process works well.
- First Nations peoples are participating more in forest management planning and getting more involved in the forest-based economy.
- During the reporting period, the ministry reduced direct spending on research. However, new protocols for tracking funding invested by partner research organizations and acquisitions of external funding, such as significant Living Legacy Trust funds, documented an increase in total research spending. It was not clear if total spending by all partners had actually increased.



What is the future for state of the forest reporting?

- The production team is steering the state of the forest report towards becoming a web-based "living document," which would allow ministry staff to update indicators on their natural schedule. For example, some economic indicators may change monthly, while some ecological ones, due to the time scale at which they operate, may show significant change only after a decade or more.
- Priorities to improve the scientific credibility of the reporting include creating teams to take on key tasks, such as validating indicators (research function) and collecting, monitoring, analyzing, and reporting on data for individual indicators (program function). What's more, the ministry is now taking steps to make dramatic improvements in the provincial forest resources inventory, which should greatly improve future data feeding into reporting. For example, raw forest inventory data will be collected and interpreted every 10 years rather than every 20, making it much more relevant for reporting.
- Climate change, forest industry instability, and invasive alien species are important issues the ministry must monitor and report on.

State of Forest Report 2006 should be available later this year, depending on the pending Cabinet approval. The paper summary and the CD-ROM will be distributed to ministry offices and known clients for the report. Others can order it from the Natural Resources Information Centre (800-667-1940) and the ministry's online store (themnrstore.mnr.gov.on.ca).

Photo: Trudy Valtinen, OFRI

Researchers Pengxin Lu and Darren Derbowka run tree seed through an automated counting machine in the OFRI genetics lab. For the state of the forest report, Lu assessed the genetic diversity of seed from Ontario's black spruce and jack pine seed orchards. Genetic diversity of tree seeds is an indicator of the sustainability of Ontario's forests.

For more about criteria and indicators at the provincial, national, and international scales ....

- For complete information about Ontario's criteria and indicators framework, including descriptions of all criteria, elements, and indicators, see Chapter 4 of the *State of the Forest Report 2006*.
- For Canada's framework, visit the Canadian Council of Forest Ministers site at www.ccmf.org.
- For the international framework, visit the Montreal Process site at www.mpci.org.

State of the Forest Report 2006: Who's who?

The core production team, all current or former staff with the Ministry of Natural Resources' Forests Division in Sault Ste. Marie, are Lindsay Abbott, Emmanuel Asinas, Steve Banducci, Rhonda Bateman, Bill Dalton, Sheila Madahbee, Robert Mears, Bill Morrison, Roj Miller, Greg Pawson, Vern Nichols, Karen Speers, John Stephens, Colin Templeton, Betty van Kerkhof, and Larry Watkins. Chris Walsh is the manager overseeing the project.

Ministry members of the state of the forest report steering committee were Ray Bonenberg, director, Southern Region; Quentin Day, manager, Fish Culture Section; Fraser Dunn, acting assistant deputy minister, Science and Information Resources Division; Rich Greenwood, director, Forest Management Branch; Frank Kennedy, director, Science and Information Branch; and Charlie Lauer, acting deputy minister. Also on the committee: Faye Johnston, woodlands manager, Grant Forest Products, and Brian Nicks, director, sustainable forest management, Domtar.

A cast of dozens contributed to the report as indicator experts; see the *Acknowledgements* section for a list. All ministry divisions made a significant effort to review the report and suggested improvements.

Does size matter for white pine seed?

By Abigail M. Obenchain

Probably only early on a tree's life, report OFRI research scientists Tom Noland and Bill Parker. They conducted a study on the variation in seed characteristics of eastern white pine in two white pine shelterwood stands near Grundy Lake Provincial Park in central Ontario, as well as the effects of that variation on regeneration success.

Some of the notable findings from their work on white pine seed mass and characteristics include:

- For the seed they collected (in two superior seed years: 1996 and 2000), larger ones tended to come from trees that had a larger crown (greater live crown ratio) and a lower height:diameter ratio. "In other words, fatter trees with larger crowns seemed to produce larger seeds," Noland explains. "However, these trees also produced fewer seeds."
- Variation in seed yield per cone, soundness of seed, and seed mass varied more within a seed year than between the two stands or the two seed years.
- Larger seeds produced larger seedlings, but this effect petered out within a few years of germination. "Whether the seed

Photo: Trudy Vaittinen, OFRI

OFRI research on white pine seed characteristics may help tip the odds in favour of successful white pine regeneration.

lands in a favourable or unfavourable location for germination is more important to regeneration success than seed size is," Parker asserts.

- Seeds collected in 2000 were more likely to be sound, possibly due to a warm, early spring that was more favourable for seed development.

"2006 was also a good seed year in these stands," Noland reports, "so we collected more seed last fall. We are now testing germination of seeds collected from three unharvested control stands and the three shelterwood stands to see if seed viability is affected by partial harvesting."

This year's activities also include collecting 10-year data for a field study of the effects of five seedbed/stand type combinations on three sizes of white pine seed to determine the relative role of seed mass and seedbed quality on natural regeneration, Parker says.

Both researchers are hopeful that improving understanding of how white pine seed varies will help ensure that more seedlings survive and that Ontario's white pine populations remain stable or even grow.

This study grew out of a larger project that focused on how shelterwood harvesting affects second-growth white pine stands in central Ontario. This project was led by Andrée Morneault of the ministry's Southern Science and Information Section in North Bay (for more information, visit the Canadian Ecology Centre-Forestry Research Partnership website at http://www.forestresearch.ca and click on *Product Catalogue – Factsheets*).

If you'd like to know more about the results of the white pine seed study, see the articles listed below. Reprints are available from OFRI. Call the OFRI publication request line at (705) 946-2981, ext. 271, or send an e-mail to information.ofri@ontario.ca.

- *Natural Variation in Seed Characteristics of Eastern White Pine (*Pinus strobus *L.) – New Forests*
- *The Effects of Seed Mass on Germination, Seedling Emergence, and Early Seed Growth of Eastern White Pine (*Pinus strobus *L.) – New Forests*
- *Effects of Seed Mass on Early Seedling Growth of Five Eastern White Pine (*Pinus strobus *L.) Under Contrasting Light Environments – Canadian Journal of Botany*

How much vegetative competition is too much? *10-year results!*

By Lisa J. Buse

If OFRI researchers have their way, the answer to that question may soon be only a few clicks away. They and others have been studying various methods of controlling plants that compete with valued crop trees for some time. Given the many possible combinations of crop tree species, competitor species, and control treatments, not to mention differences in seedling stock types, treatment timing, site conditions, and other confounding factors, is it possible to generalize the results of these studies?

"To a certain extent it is," asserts OFRI research scientist Wayne Bell, who with partners has been following up on many of the older vegetation studies in the province over the past decade. "We've been working with 10 years of post-treatment data from well-designed studies across the province, all of which used similar data collection protocols. "We started with some ideas about competitive mechanisms from the literature, our experience, and individual study results, from which we derived a series of questions, and now are querying the data in a systematic way to test those ideas."

Consistent data collection critical for linking studies

Data collection protocols used in most of these studies are those that Bill Towill, science coordinator at the Ministry of Natural Resources' Northwest Science and Information in Thunder Bay, advocated in a report entitled *A Competition Index Methodology for Northwestern Ontario*, published in the early 1990s.

Towill explains, "With so many different people collecting data on research studies as well as for operational regeneration and free-to-grow surveys, we knew we needed a consistent protocol. If everyone uses the same system, then data from multiple studies can be merged and used to better understand competitive mechanisms and support model development."

And just how does one extract data patterns from multiple studies? Project partner Frank Schnekenburger of Spatialworks in Sault Ste. Marie says the key is to compile an organized, consistent, and clean database. "We've compiled the data from over 15 different studies from Espanola, Ontario west to The Pas, Manitoba into a unified database that can be easily queried.

"For crop trees we have data on survival, height, and root collar diameter, and for competitor species we have data on height and percent cover [percentage of the ground area covered] by species. Because analyzing the effects of some 220 competitor species separately didn't seem practical, we've classified the competition

into classes – graminoids [grasses], forbs [other non-woody vegetation], low shrubs, medium shrubs, woody deciduous trees, and woody coniferous trees. Initially, we're looking at the relationships between percent cover of competitive vegetation and crop tree growth by individual crop species and for all crop species combined."

Seeking a new tool to decide need for vegetation management

"The ultimate goal is a diagnostic computer tool," Schnekenburger emphasizes. "Preferably it would be based on relatively easily measured field attributes that can be used to predict effects of treatments on survival and growth for a given species and site condition. We're trying to simplify a complex system and reduce the data collection needed to help resource managers to determine the need to release crop trees from competition."

Andrée Morneault, vegetation management forester with the ministry's Southcentral Science and Information in North Bay and an advisor to the project, says, "I see this approach being used to bring more science into assessing competition and its effect on crop tree growth. For example, we can develop a protocol for assessing competition – when best to do it and what to measure. Or we can use it to ensure optimum timing of vegetation management treatments or to assess the cost/benefits of alternative vegetation management strategies – do we take the *wait and* see or the *do it now* approach? Hopefully, foresters will be able to use the resulting tool or model to regenerate forests after harvest and to conduct *free-to-grow* surveys [to determine if young trees are free of anticipated growth barriers such as competition]."

"There's a wealth of information in these studies that will help to improve our understanding of early stand dynamics," emphasizes Bob White, forest science specialist with the ministry's Northwest Science and Information in Kenora and project advisor. "This understanding will give us a better grasp of key competitive interactions during the critical and complex regeneration stage of stand development and will help identify trends that can be incorporated into the next generation of decision support tools."

OFRI researcher Mahadev Sharma is supporting the modelling aspect of the project. "I'm looking forward to using my modelling expertise to help develop a practical tool for resource managers," he says. "With any luck, we'll have a published model that's available for use by next year's field season."

Bell asserts, "We've evaluated many treatments, applied at various times and at different intensities on a variety of sites to our most common crop tree species – black spruce, jack pine, white spruce, white pine – and are starting to see some patterns. It's these patterns that will be built into the model. We know that through proper renewal planning and vegetation management, you can influence the species composition of the resulting stand as well as the survival and growth rates of individual crop species – it's *how much* that's in question."

Interim advice for managing vegetation

While the modelling work is just beginning, herbaceous (non-woody) vegetation seems to be the major source of competition in the first three years after establishment, with woody vegetation being competitive much longer. "If you're targeting competition, it makes sense to tackle the herbaceous first and then the woody," Bell says.

"We've known for some time that height growth is much less sensitive to competition than is diameter, but above a given percent cover a threshold shows up five to 10 years after planting. Both the threshold and the impact differ among crop species. These are the types of relationships we hope to extract from this database to help forest managers assess the risks and benefits of competition control treatments over the longer term."

Some studies show that some species combinations don't work on some sites. "For example, while a low-growing species such as large-leaved aster may seem harmless, it's a major problem for jack pine on clay," Bell explains. "Not because it's competitive but because it acts as an alternate host for a pine needle rust that wipes out the pine. These are the types of surprises we hope to help resource managers avoid by sharing our results."

When asked if he could provide any specific recommendations at this point, Bell says his advice would probably not be news to practicing foresters. "Especially for jack pine, get in there as quickly as possible after planting, preferably late summer-early fall in the same year, or for natural regeneration, immediately after harvest, and knock the competition back before it gets established. That way, more resources are available to the crop trees. If possible, particularly on productive sites, conduct a second treatment a year or two later to ensure crop trees reach free-to-grow status quickly."

While spruce is more tolerant and will survive despite some competition, if you want maximum volume the same principles apply as with jack pine. "White pine, however, is different," Bell reports. "Initially you want to remove the herbaceous competition but keep some of the woody cover to protect the seedlings from blister rust and weevil. Over the longer term, woody competition will also need to be controlled for best growth."

Photo: Jessica Bolduc, OFRI

A research technician assesses crop tree regeneration on a vegetation management study site.

Bell and his collaborators have worked hard to ensure that the studies worth following up on were remeasured and the results summarized and transferred to resource managers in a number of ways – through presentations at workshops, as part of field tours, and as summaries on the web. This transfer will need to continue as staff turnover continues. As well, they are ensuring that the results get into scientific journals to make the information available to other researchers.

He concludes, "We now have good data that can be synthesized and used to develop a model or tool that has more widespread use, so that's what we're focusing on for the immediate future. We hope that the Canadian Ecology Centre-Forestry Research Partnership (CEC-FRP) will continue to assist in transferring the results of this work."

For the moment, results of individual vegetation management studies being used in the competition threshold work are posted on the CEC-FRP web site at www.forestresearch.ca. Click on *Projects – Projects by Category - Fibre Production - Old Trial Remeasurement for Intensive Forest Management*.

The modelling work is being funded by the Enhanced Forest Productivity Science Fund through a partnership with Nancy Luckai, Lakehead University. Remeasurements were made possible with funds from the ministry, the CEC-FRP, Living Legacy Trust, forest industry partners (Bowater, Domtar, and Tembec), Natural Resources Canada-Great Lakes Forestry Centre, and the Agricultural Research Institute of Ontario. Manitoba's Natural Resources Forestry Branch and Forest Protection Ltd., New Brunswick, also sponsored data collection. For more information about these projects, contact Wayne Bell at (705)946-7401, wayne.bell@ontario.ca.

The white pine pill: Another potential tool to fend off blister rust

By Abigail M. Obenchain

Ask any forester why it s so difficult to get eastern white pine to grow, and in most cases, blister rust will top his or her list of regeneration headaches. This disease, imported from Europe early in the 1900s, has contributed to a dramatic decline in white pine across its range in Ontario and in all five-needled pines across the continent. It is especially deadly among young pines, able to cause close to 100 percent mortality.

Photo: OFRI Forest Health and Pathology Program

Planting a pill that contained fungicide, insecticide, and fertilizer under white pine seedlings helped to ward off the damaging effects of blister rust, white pine weevil, and competing vegetation.

Researchers have been confronting the white pine blister rust challenge in several ways. For example, some have been investigating using shelterwoods (sites with some shade trees left after harvest) to create an environment that discourages blister rust. Others are developing blister-rust resistant pine through controlled crossbreeding with related species from Europe and Asia that have some resistance to the disease.

Back in the mid-1990s, former OFRI pathology researcher Tim Meyer decided to investigate a different approach to the blister rust problem: What if a pill containing a fungicide (to prevent blister rust), an insecticide (to deter white pine weevil), and a fertilizer (to spur growth and increase the trees' competitiveness) was planted under each seedling to help them survive those critical years when blister rust is so lethal?

The final results of this research are discussed in a recent *Canadian Journal of Forest Research* paper authored by Doug Pitt of the Canadian Forest Service-Great Lakes Forestry Centre, along with Meyer and several others.

"Dr. Meyer designed this study to test the hypothesis that the application of slow-release tablets containing a fertilizer [N:P: K], fungicide [Bayleton® with triadimefon as the active ingredient], and insecticide [Merit® with imidacloprid] would improve the long-term survival, health, and growth of white pine seedlings," Pitt explains. "The results indicate that the tablet dramatically reduced the infection rate, the proportion of both main-stem and branch infections, and mortality on all three test sites through seven growing seasons after planting, illustrating that the tablet is an effective fungicide delivery system.

"However, while we learned that this tablet can improve the short-term survival, growth, and health of white pine seedlings, it was also clear that this treatment should not be used in isolation. Rather, such a tablet should serve as a component in an intensive, integrated pest management strategy that also includes avoiding planting in areas at high risk of blister rust, using shelterwoods, using timely and effective vegetation management, regulating stem density, and pruning lower branches."

Pitt adds that one of the sites (in Algoma District) received annual vegetation control through the application of a glyphosate herbicide (Vision®), along with the tablet treatment. "The trees at this site were more than six times larger than the fertilized trees on the other sites. The gains associated with vegetation management overshadowed any gains associated with fertilization. Most likely the early competition control, especially of broadleaf non-woody plants, grasses, ferns, and low shrubs, resulted in greater gains than direct fertilization did, due to increases in soil temperature, available nitrogen, and available soil moisture."

Despite the primarily positive results, this pill will likely not be used in Canada, as Bayleton® is no longer available here. "However, it is possible that a tablet with similar efficacy could be produced," Pitt says. "In fact, Michael Irvine with the ministry's Forest Health and Silviculture Section in Sault Ste. Marie and OFRI's Pengxin Lu are currently screening possible replacements for this fungicide. But the relatively small forestry market could make it difficult to encourage chemical companies to invest in such a pill."

However, if it means saving Ontario's provincial tree, which has such high economic, ecological, aesthetic, and cultural value, from the same fate that has befallen species such as the American chestnut and American elm, it might be worth the cost. Pitt points out that in some areas of Ontario, white pine regeneration has been abandoned as hopeless due to the disastrous double threat of blister rust and white pine weevil.

For more information about the white pine pill, contact OFRI to request a reprint of *Application of Slow-Release Tablets to Enhance White Pine Regeneration: Growth Response and Efficacy Against White Pine Blister Rust*. You can call the OFRI publication request line at (705)946-2981, ext. 271, or e-mail information.ofri@ontario.ca.

Bioindicators researchers develop forest condition rating systems for several tree species in Ontario

By Abigail M. Obenchain

In the early to mid-1990s, OFRI's Stock Quality Assessment Program became a world leader in developing physiological tests to assess tree seedling condition. As these tests became operational, preventing the planting of millions of unhealthy seedlings across Ontario, OFRI's physiology researchers decided to investigate adapting assessment of tree condition to a larger scale. Thus was born the Bioindicators of Forest Sustainability Project, the goal of which was to develop early warning systems for detecting forest decline from the air for a variety of tree species.

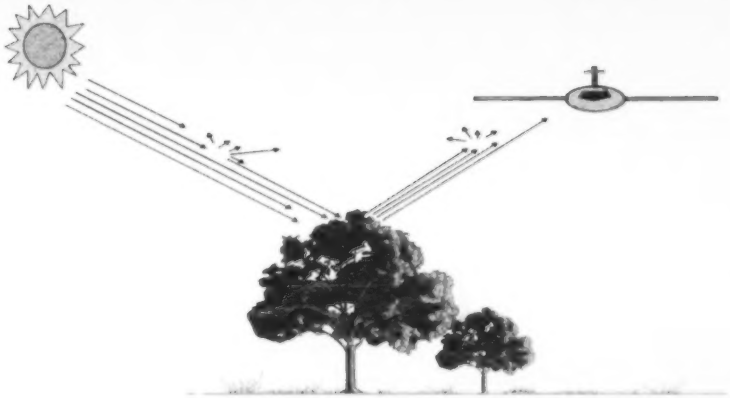
"The main drawback of traditional measures of forest health and condition, which rely on visual cues such as leaf colour, defoliation, branch dieback, growth rate, and volume, is that by the time symptoms appear, forest decline can be well underway," explains OFRI research scientist Tom Noland, a lead investigator on this project. "So we investigated using a remote sensing method – *hyperspectral sensors* mounted on aircraft or satellites – to determine forests' physiological condition."

These sensors measure the amount of light of different wavelengths reflected or emitted from plants. For the bioindicators project, researchers collected remote data at nearly the same time as ground data (tree height/diameter/basal area, leaf area index, chlorophyll and pigment spectral reflectance, and leaf transmittance). They then compared the two sets of data to determine which changes in the hyperspectral images correlated with changes in trees' physiological condition measured on the ground.

Phase 1: Sugar maple

"We first focused on sugar maple stands," Noland says. "We found that remotely sensed data on chlorophyll concentrations in maple canopies, as well as chlorophyll fluorescence, were closely correlated with the physiological condition of these stands."

He points out that chlorophyll content is an excellent measure of forest condition, because plants under stress, whether from a nutrient deficiency, changes in growing conditions, pollution, or pest/disease outbreaks, produce less of this compound, which is critical to plant life. Chlorophyll reduction becomes obvious when leaves turn yellow or *chlorotic*, but the hyperspectral imaging allows researchers to "see" tree stress before that happens.



Bioindicators researchers have produced a system for assessing the condition of maple forests using data collected from aircraft or satellites. They are working towards developing similar systems for boreal tree species.

According to Noland, he and his colleagues were surprised to discover that with sugar maple stands, hyperspectral reflectance data can also reveal the amount of canopy chlorophyll *fluorescence*, another useful indicator of tree stress. "We knew from our stock quality research that changes in leaf fluorescence can reveal the physiological condition of individual seedlings," Noland says. "But the chlorophyll fluorescence signal given off by leaves is quite small compared with the rest of the reflected light signal. We were pleased that the sensitivity of the sensor allowed us to predict the fluorescence signal from the canopy reflectance with reasonable accuracy."

Phase II: Boreal species

With a prototype system for maple in place, researchers geared up for Phase II of the project, which involved developing similar condition rating systems for black spruce, jack pine, aspen, and white birch. Highlights of their results include:

- Chlorophyll content was found to be a useful indicator of stress in black spruce, aspen, and white birch stands, as they had relatively quick reductions in chlorophyll when under stress. Further research is needed to produce a condition rating system. A campaign to improve the accuracy of chlorophyll estimates for black spruce is now underway, with Jing Chen of the University of Toronto and John Miller of York University as lead researchers.
- Jack pine was a much greater challenge, as only chlorophyll in new needles responded quickly to stress. Noland says, "When we looked at the effects of treatments such as girdling in boreal tree species, aspen foliage responded very quickly, making it relatively easy to detect decline. Jack pine needle shows little immediate change in chlorophyll concentrations, making it harder to detect decline with hyperspectral sensors."
- Hyperspectral remote sensing was coupled with lidar to improve accuracy of chlorophyll measurements. (*Lidar* is similar to radar but uses lasers rather than radio waves; it can reveal the amount and spatial structure of forest biomass.)
- Combining hyperspectral and lidar data produced more accurate estimates (than using hyperspectral data alone) of canopy chlorophyll in a mixedwood stand. This advance is significant since it is difficult to estimate canopy chlorophyll in a mixedwood stand due to tree crown variability.
- The lidar-improved estimates of canopy chlorophyll concentration were fed into a photosynthesis model to estimate primary productivity in a mixedwood stand. With further improvements, the hyperspectral/lidar estimates of chlorophyll could be used in large-scale carbon budget models.

Noland and his colleagues foresee a variety of applications for their findings, including:

- Monitoring changes in forest condition over time for state of the forest reporting
- Evaluating how forest management activities affect forest condition
- Providing earlier warning of stress (pest/disease outbreaks) in forest stands to allow

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intervention such as early harvest before major timber damage occurs

- Providing data on forest canopy chlorophyll for use in photosynthesis models that help determine primary productivity (amount of plant biomass produced in a forest)

According to Noland, operational use of this technology is still a few years off. However, he has been talking with Ministry of Natural Resources colleagues and other potential partners about whether a new digital multispectral sensor to gather forest resources inventory data across Ontario's entire managed forest area could also be used to estimate canopy chlorophyll. These estimates could be used for some if not all of the above applications.

Many partners have worked on the bioindicators project, including several universities (York, Queens, Toronto, Sherbrooke, Milano-Bicocca [in Italy]), Domtar, Dendron Resources Surveys, and Canadian Forest Service-Pacific Forestry Centre, with funding coming from the Ministry of Natural Resources, Canadian Space Agency, Centre for Research in Earth and Space Technology-Ontario Centre of Excellence, Geomatics for Informed Decisions Network of Centres of Excellence, and NASA.

For more information, contact Tom Noland at OFRI, (705)946-7421, tom.noland@ontario.ca. To learn more about bioindicators publications, visit OFRI's website at ofri.mnr.gov.on.ca and go to the *Publications* page – see the 2006 publications list and the 2001-2005 bibliography.

Two publications for stem profile model buffs

by Abigail M. Obenchain

***1. Regional Stem Profile Model for Cross-Border Comparisons of Harvested Red Pine* (Pinus resinosa *Ait.) in Ontario and Michigan* (published in the journal *Forest Science*):** During the recent softwood lumber dispute, Canada and the United States were using different methods for calculating wood volume, which made it difficult to compare wood markets in the two countries. In this publication, OFRI modeller Voyteck Zakrzewski and a colleague at Michigan State University describe how they developed a stem profile model for red pine that is valid for both Ontario and Michigan, allowing cross-border comparisons of wood volume and thus timber prices. This model is just one of many that Zakrzewski is working on as part of his Great Lakes Stem Profile Modelling Project.

***2. Stem Data Management System for the Great Lakes Stem Profile Modelling Project Version 2.0* (OFRI Forest Research Note No. 67):** This note describes software that Zakrzewski and partner Frank Schnekenburger (Spatialworks/Sault Ste. Marie) developed to support the modelling project. This software allows researchers to integrate stem profile-related data from a variety of sources and in various formats into a single, unified, user-friendly database. The system's components consist of a database and software modules for processing data and rely on SAS 9.1.

Zakrzewski notes, "To supplement the stem data management system, we've also produced a new piece of software entitled *Visualizer*, which allows us identify errors in measurement visually through analyzing tree-specific graphs. It helps us to verify tree measurements across the huge dataset, which includes data for more than 23,000 trees. Both the stem data management system and Visualizer will be uploaded to the web soon for forest mensurationists to use."

To obtain the two publications, call (705)946-2981, ext. 271, or e-mail information.ofri@ontario.ca. For a more detailed article about using stem profile models in cross-border comparisons of timber volume, see *Insights* Vol. 7, No. 2.

Final study in Ontario's ice damage science program reveals longer-term effects

By Abigail M. Obenchain

Immediately following the ice storm that hit eastern Ontario and much of northeastern North America in 1998, several government agencies, including the Ministry of Natural Resources, set up a series of studies that focused on the recovery of forests following this dramatic and sweeping disturbance.

Results of the final study in that series are highlighted in an OFRI Forest Research Note, which focused on "the longer-term effects of applying fertilizer in sugar maple stands that lost from 7 to 72 percent of their crowns due to ice deposits of up to 10 centimetres," explains OFRI biochemistry research scientist Tom Noland, who led the study. "We had data for the effects after three years but felt that it was important to get a longer-term view. Fortunately, we received funding from the Canadian Climate Impacts and Adaptation Program to do so."

Their final conclusions about the effects of ice damage in maple sugarbushes? "Moderate to severe crown damage can reduce syrup production 20 to 30 percent, and these effects can last up to six years or seven tapping seasons," Noland says. "This reduction will occur whether the crown damage is caused by an ice storm, a wind storm, or any crown damage event. Fertilization does not appear to have significantly affected the ability of trees to recover."

The most important message to take away from this research: Moderate to severe damage will affect some sugarbushes but not all and not every year. The effects depend on how old and in what condition the trees were in when the damage occurred, as well as whether they experience additional stress in the following years, such as drought, nutrient deficiency, or disease.

"In other words, trees are resilient," Noland says. "The younger and more adaptable trees tend to recover quicker and are less affected than older trees growing on similar sites."

To obtain a copy of *Ice Storm and Fertilization Effects on Root Starch, Sap Productivity and Sweetness, Diameter Growth, and Tap Hole Closure in Sugar Maple Stands of Eastern Ontario* (OFRI Forest Research Note No. 68), call (705)946-2981, ext. 271, or e-mail information.ofri@ontario.ca.

Other sources of information about Ontario's ice damage research:

- The *Journal of Forestry* published a summary of ice damage research and extension efforts early this year; reprints are available from OFRI.
- For a previous and more extensive summary of research into the effects of ice damage due to the 1998 storm, see OFRI's *Insights* newsletter, Vol. 6, No. 2. To download, visit ofri.mnr.gov.on.ca (go to the *OFRI Publications page*).
- OFRI's 2001-2005 bibliography lists many scientific articles about ice damage research, single copies of which are available from OFRI on request. To download, visit ofri.mnr.gov.on.ca (*Publications*).

What is a stem profile model?

A stem profile model is a mathematical representation of the shape of a given tree species' stem. It allows for precise calculation of timber volume and helps to ensure that mills will get the optimal mix of lumber products from that stem shape.

• Forest Research and Development Section manager **Wayne Fiset** is in an acting assignment as executive assistant to Bill Thornton, assistant deputy minister of the Ministry of Natural Resources' Forests Division in Sault Ste. Marie. He is slated to return to OFRI in December.

• **Paul Ward** is replacing Wayne during his acting assignment. Paul's home position is as manager of Business Solutions Services-Forests, with the Ontario government's Land and Resources Cluster. He has a forestry degree from the University of Toronto and over 30 years of experience with the ministry, in positions such as unit forester, provincial coordinator of the Forest Fire Science and Technology Program, and information management coordinator for Aviation and Forest Fire Management.

• Farewell to **Mark Parsons**, who left his science coordinator position at OFRI for a new challenge as policy and business manager with the ministry's Aviation and Forest Fire Management Branch. Mark was with OFRI from June 2001 to March 2007.

He says, "Serving as a science management coordinator at OFRI was a rewarding experience both personally and professionally. I thoroughly enjoyed working in a research environment within the ministry, for which I had little appreciation prior to my arrival. The world of research is unique and offers an opportunity for continuous learning. Looking back, I would say my greatest accomplishment was having the leadership opportunity to work with very talented and extremely dedicated individuals who will help you however they can without question. I wish to acknowledge all the staff at OFRI and thank them for allowing me to lead them, share in their many successes, and be part of their research legacy."

• Hardwood ecosystem research scientist **Bill Cole** is acting in Mark's position until the fall.

• Farewell to research technician **Mya Park**, who first began working with the ministry's forest pathology research team as a summer student in the late 1980s, before the OFRI building in Sault Ste. Marie opened. Mya spent several years working on the white pine pill project (see related article in this issue) and more recently was part of the forest ecology research team, working on the NEBIE project (see related article in this issue) and others. We wish her well in as she pursues a new career as a teacher.

• Congratulations to **Sandra Wawryszyn**, who joined OFRI full time in September 2006 as a forest soil and water research program assistant (see related article on this program in this issue). She first came to OFRI in 2001 to provide technical support to the boreal mixedwood research team. She has a forest technician's diploma from Sault College and a degree in natural resource management with a major in forestry from the University of Northern British Columbia. She is also a member of the Canadian Institute of Forestry.

Sandra says, "I'm looking forward to contributing information and data that will support forest management in multiple areas, especially mitigation or adaptation efforts related to climate change. I work with Jim McLaughlin, an extremely dedicated research scientist at OFRI, who has given me the opportunity to learn and think about so many different aspects of forest management, particularly how nutrients, disturbances, and climate change interact."

Q. What are some of the more promising non-timber forest product opportunities for northern Ontario?

OFRI's Tom Noland answers:

Canada yew is one non-timber forest product that has a market, and we are already studying how best to produce yew in an agriculture setting to maximize the amount of the chemical paclitaxel, an important cancer drug ingredient found in this shrub's foliage. Pharmaceutical companies are still paying for yew biomass. However, the business is rapidly changing, and harvest is about to become mechanized. The future belongs to the most efficient growers and harvesters! Other possibilities:

- Wild blueberries have great market potential, especially in Europe. Some companies will buy large quantities, making this forest crop a great opportunity for an enterprising entrepreneur.
- Bio-oil and its byproducts are likely to be in demand in the next five years or so. Technologies for using this bioproduct are still being researched. The ministry is now running a pilot project to build and test a transportable biorefinery that will refine bio-oil from unused forest biomass (such as branches from cut trees, poor-quality cut trees not worth taking to the mill, etc.).
- Birch bark is a source of the chemicals betulin and betulinic acid, which have been shown to control the HIV virus, to kill bacteria, and even to help control some types of cancer. Clinical trials have begun to test its medicinal properties. Again, this product is more likely to be a commodity of value in five to 10 years.
- Chaga, a fungus found on birches and sold for medicinal purposes in Europe and elsewhere, is already being harvested in Ontario's Algoma District. More work is needed to determine its market potential.

Given the challenges facing Ontario's traditional forest products industry, non-timber forest products are well worth investigating, for both researchers and entrepreneurs.

Upcoming events

November 14-15: *Adapting to Change: Managing Tree Seed in an Uncertain Climate,*

Sault Ste. Marie, Ontario. Sponsored by the Ministry of Natural Resources' Climate Change Initiative and Forest Genetics Ontario. Suggested audience: Forest managers and researchers who are concerned about the effects of climate change on managing tree seed resources. For more information, contact Kathleen Brosemer, provincial coordinator, Forest Genetics Ontario, (705)942-4907, cell (705)255-2801, kbrosemer@fgo.ca, www.fgo.ca or Barb Boysen, coordinator, Forest Gene Conservation Association, (705)755-3284, cell: (705) 875-7150, fax: (705)755-3292, barb.boysen@ontario.ca, www.fgca.net, www.ontariosnaturalselections.org.

OFRI Research Trivia!

1.What are the Ministry of Natural Resources' genetic archives, which retired OFRI senior research technician Bob Sinclair spent years protecting?

a. A computer-based recordkeeping system for OFRI's genetics research program
b. A wing of the ministry's library dedicated to genetics publications
c. A DNA data bank for all of Ontario's tree, fish, and wildlife species
d. Tree plantations that house trees that contain valuable genetic attributes, such as superior growth or resistance to disease

2. What pest is a major factor in recent widespread aspen decline in northeastern Ontario, the successional effects of which are being investigated in a study led by research scientist Rongzhou Man?

a. Hypoxylon canker b. Forest tent caterpillar c. Armillaria root disease d. Gypsy moth

3. True or false: Old growth white pine (120+ years) did not respond well to thinning in a partial harvesting trial in Algoma District led by research scientist Bill Cole.

Answers

1. d. A genetic archive is a living tree library of genetic material. The ministry has several archives in southern Ontario, some of which date back several decades. The newest archive is being developed at the OFRI arboretum outside Sault Ste. Marie. The ministry's archives are valuable because most of the critical records of research on genetic material contained in each tree have been preserved.

2. b. Back-to-back infestations of forest tent caterpillar in the aspen-dominated stands in the Cochrane-Hearst corridor, where infestations peaked in 1992 and 2001, have lead to a dramatic increase in aspen decline and mortality. Man and his colleagues are investigating how this decline is affecting successional patterns in these forests.

3. False. In this study, old growth white pine actually responded well to thinning, with up to 60 percent increases in diameter growth over eight years, compared with 10 percent or less in uncut stands.

For more information about these topics, see Insights Vol. 7, No. 2

Insights
Publication of the Ontario Forest Research Institute

Have a suggestion?

Want more information on a research project?

We want to hear from you!

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Publication request line is ext. 271

50808
(1.8k P.R., 07 07 25)
ISSN 1204-0436

2007, Queen's Printer for Ontario
Printed in Ontario, Canada

This paper contains recycled materials